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DESIGN AND DEVELOPMENT OF ANIMAL DRAWN SEED CUM FERTILIZER APPLICATOR FOR DIRECT SEEDED RICE

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ABSTRACT

Direct seeding is one of the cultivation practices of rice crop. With the advancement in management practices, direct seeding of rice is being preferred over transplanting method, by a number of farmers. The existing eight row paddy drum seeder was suitable for line sowing of paddy crop but it requires high seed rate, human stress and there is no provision for fertilizer application. Therefore, to overcome high human stress and drudgery in rice cultivation, a low cost four rows animal drawn seed cum fertilizer applicator was designed and developed in the workshop at the department of Farm Power and Machinery Engineering, FAE, IGKV, Raipur which will be suitable for sowing seeds with fertilizers. It was tested in the laboratory and in the field with paddy seeds and fertilizer (DAP granules). It has two drums for applying seeds and two drums for applying fertilizer which were placed over a shaft. The power to the shaft was given through the ground wheel. Each drum had two rows with 25 cm spacing. The machine had four rows with the working width 100 cm and the average depth of seed and fertilizer was 4.80 cm. The seed and fertilizer rate was found 10.59 and 12.40 kg/ha respectively. The draft was measured 35.97 kgf and power was 0.23 kW which can be easily pulled by local draft animals. The operational energy was computed 94.38 MJ/ha. The effective field capacity of the machine was found 0.138 ha/h at an average speed of 2.26 km/hr and field efficiency was 61.57%. The estimated cost of the machine was Rs.3762 and the cost of operation was found Rs.304.13/ha. The overall weight of the whole machine was only 37 kg which is easy to operate and farmers can easily handle it.

KEYWORDS: Drum Seeder, Fertilizer, Field Capacity & Field Efficiency

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Original Article

INTRODUCTION

Rice is a major crop grown in Chhattisgarh. This crop is grown mainly in Kharif season. Traditional practices of rice cultivation adopted by a majority of farmers in Chhattisgarh are broadcasting followed by ploughing with narrow share indigenous plough (Busanae) and transplanting. These practices involve either high input cost or high labour cost. Moreover, broadcast rice cultivation has less plant population, less tillers per plant, low yields, high weed population. Transplanting method needs higher quantity of water and that is also at right time. These problems associated with the traditional practices have resulted in a need to find out a solution to these problems. These traditional practices can be replaced with line sowing using an efficient seeder, leading towards saving of water, seeds and labour.

The existing drum seeder is a machine used to sow soaked seeds in puddle field condition. This machine can also be used for dry seeding with a little modification. But it is suitable for sowing of seeds only without any provision for fertilizer application. The present machine under this study is a four row paddy drum seeder cum fertilizer applicator. It is animal operated, low cost equipment and is simple in construction. The advantage of

drum seeder is that row to row spacing can be easily maintained and dropping of seeds and fertilizer is done in single operation.

This machine could be an effective mean for timely sowing of rice resulting in 7 – 10 days early maturity and higher yields.

MATERIALS AND METHODS

A Paddy drum seeder cum fertilizer applicator was designed and developed in the workshop of FAE, IGKV Raipur. It comprises of drums (2 for seed and 2 for fertilizer), Frame, Ground wheel, Shaft, Sprocket, Chains, Channel, Tyne, Handle, Hitch and Beam.

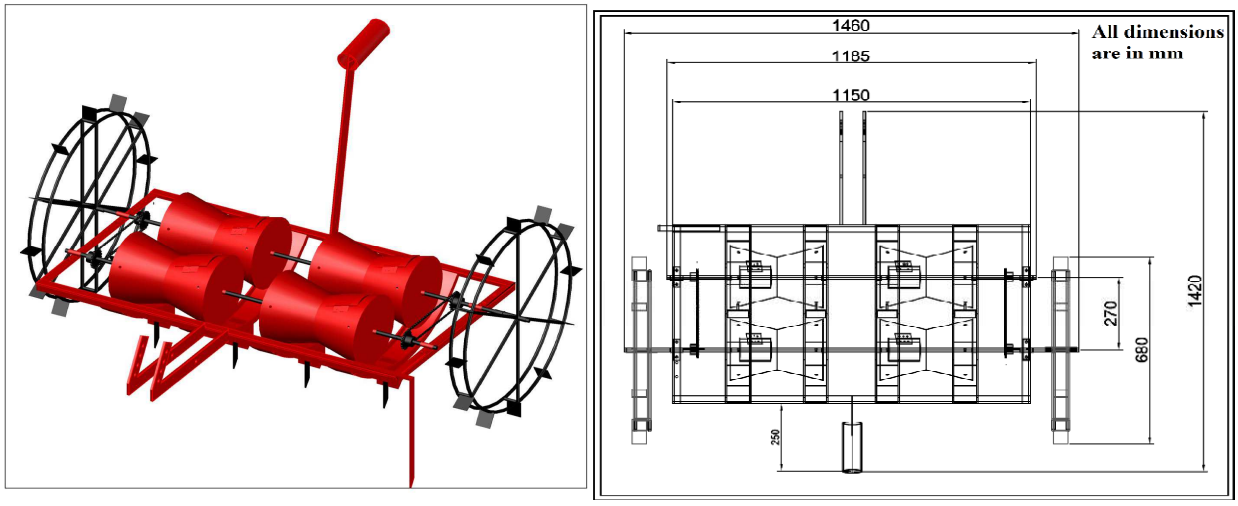
The components of the paddy drum seeder are as follow:

- **Drum**

This is made up of G.I. sheet of 18-gauge thickness. The diameter of drum was kept 230 mm and the length was 300 mm. The shape of the drum was hyperboloid in shape. Three no. of metering orifices (holes) were provided on the surface of the sheet (11 mm for Seed and 8 mm for DAP granules) according to the physical dimension of seeds and fertilizers and requirement of the seed rates and fertilizer rates.

- **Frame**

The frame was fabricated by welding 25×25×5 mm mild steel angle iron pieces together keeping in view the orientation and attachment of different components. The length of the frame was 1150 mm and width is kept 650 mm made of mild steel.



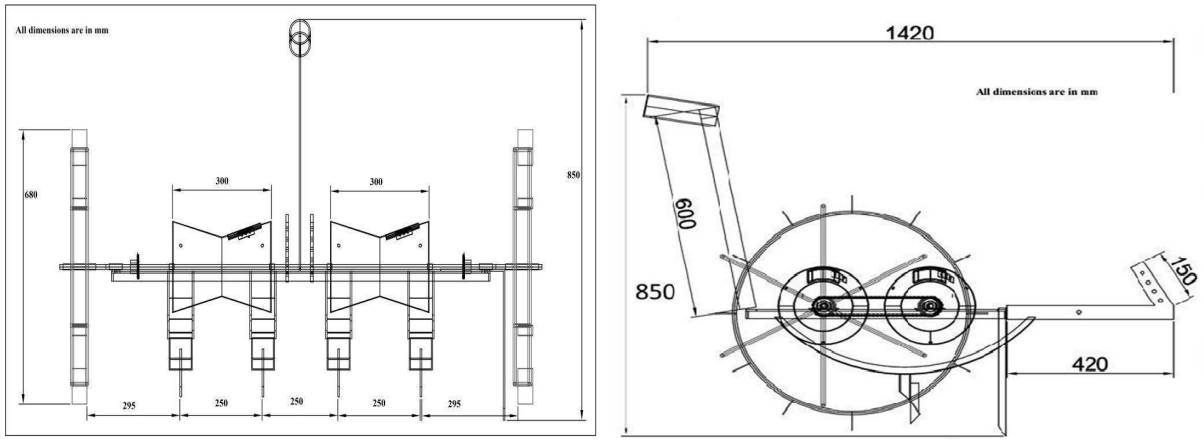


Figure 1: Different Views of Seed cum Fertilizer Applicator

- **Ground Wheel**

Ground wheel of 580 mm diameter was selected for the designing of the wheel. The wheel is made of M.S. Rod (10 mm dia) and width is kept 50 mm. The spokes were made up of mild steel round bars of 10 mm diameter 12 spokes were provided on each wheel. Lugs are also provided on the ground wheel for better traction of machine on the field the lugs are made of G.I. Sheet of 16 guage thick.

- **Shaft**

Shaft is made of M.S. Rod of 12.5 mm diameter. Two shafts were provided on the machine the ground wheel shaft and the transmission shaft.

- **Power Transmission Unit**

The power is transmitted from the ground wheel to the shafts which rotates the drums filled with seeds and fertilizer with the help of chains and sprocket drive**.**

- **Channel**

Channel is a place where the seed and fertilizers falls from the drum. It is made up of 20×5 mm M.S. Flat and G.I. Sheet of 16 guage thickness. The length of channel is kept 650 mm and width of channel is kept 60 mm. M.S. Square pipe of 30 mm were welded on the lowest point of the channel from where the mixture of seeds and fertilizers drop downs to the ground.

- **Tyne**

Tynes of a sowing device are the final modifier of soil environment in a seedbed. Hence, they are one of the most important components of an animal drawn seed cum fertilizer applicator. Tyne is made from MS Flat of 20×5 mm and length is 120 mm. Four tynes are provided for four rows.

- **Handle**

The handle was made of mild steel having a grip of mild steel pipe of 32 mm Outer diameter and 180 mm in length. The grip was welded to the flat plate of 40×5 mm of 600 mm long. The handle was made attached to the main frame by welding.

- **Hitch and Beam**

The hitch was made up of mild steel flat of 40×8 mm with length of 420 mm. The hitch was welded on the front of frame from lower side. Single beam (MS pipe: 50 mm) of 3000 mm was selected. The beam was hinged to the hitch. The height of the yoke may be adjusted with the help of nut and bolts provided to change the position through the holes drilled on the hitch.

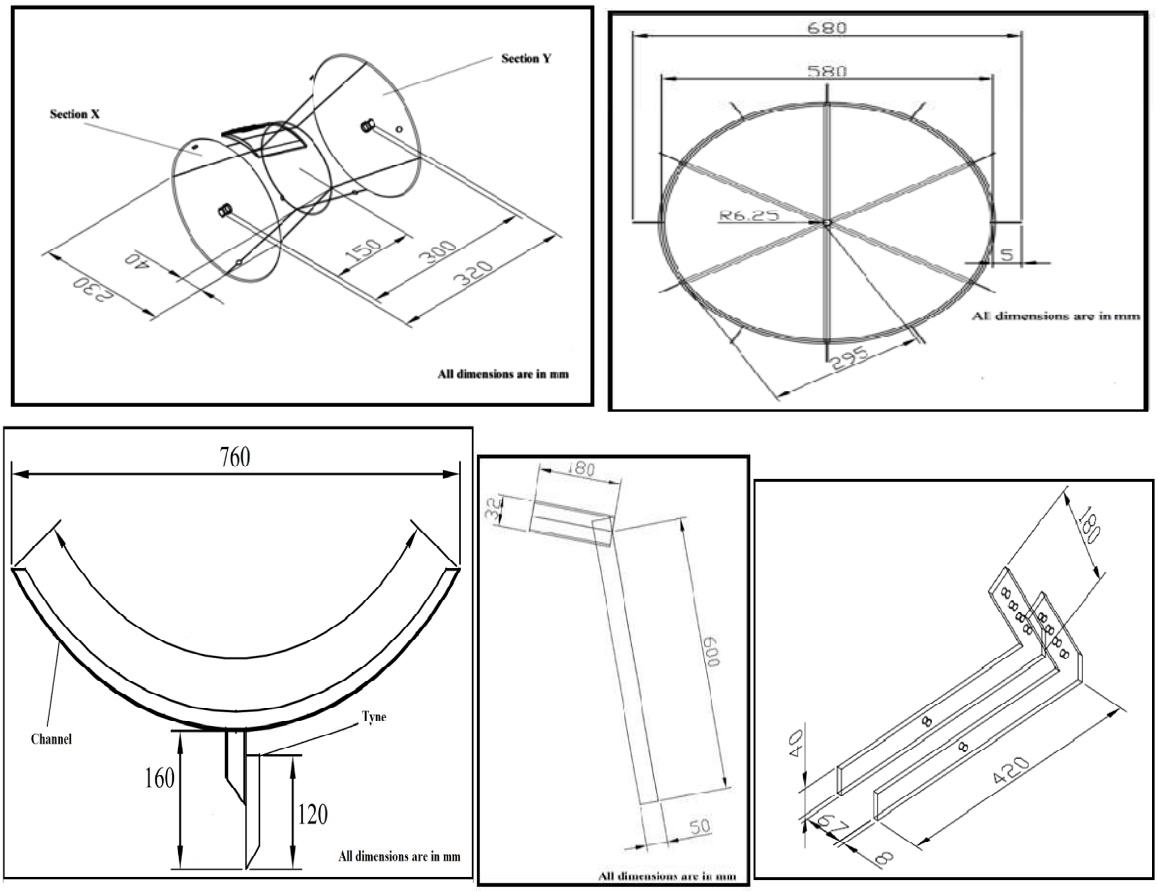


Figure 2: Autocad View of Different Components of Drum Seeder

METHODOLOGY

The machine was operated and the following performance feature was noted:

Depth and Placement of seed and fertilizers in row

- Speed
- Power
- Field Capacity
- No. of plants/m^2

To carry out the evaluation, the performance of the constructed paddy drum seeder was conducted on the experimental field of Faculty of Agricultural Engineering, IGKV Raipur.

Performance Indicators

Performance indicators used for this experiment includes the following:

Depth and Placement of Seed and Fertilizers in Row

The seeder was operated in the field under normal seedbed conditions. A distance of 5 m length was covered and the soil was removed carefully without disturbing the seeds and fertilizers. Then the depth and placement of seeds and fertilizer were measured.

Operating Speed

The speed of operation was measured by recording the time required to cover 20 m distance in the field during operation.

Speed (km/hr) = 3.6 x distance traveled (m)/ time (s)

Power Requirement

The power requirement was determined from draft and speed using the relation

$$\text{Power (hp)} = \frac{\text{Draft} \times \text{speed}}{75}$$

Where, Draft in kgf; and Speed in m/s.

Field Capacity

On the basis of the width of furrow and speed, theoretical field capacity was calculated by following formula (Kepner *et al*., 1960).

$$\text{Theoretical Field capacity (ha/h)} = \frac{\text{W (m)} \times \text{S(km/h)}}{10}$$

Where, S = Speed of operation, km/h; W = Theoretical width covered, m; and W = No. of furrow openers multiplied by distance between two consecutive furrow openers, m.

No. of Plants/m^2

Number of plants per square meter was counted from each of the five randomly selected one meter quadrates after the 25 DAS (Days after Sowing).

RESULTS AND DISCUSSIONS

Paddy seeds were sown using four row paddy drum seeder with fertilizer attachment. The test conditions during the field trial are given in Table 1. The seeds and fertilizer (DAP granules) were filled in the drums and the seeder was operated in the field condition. The field performance of the paddy drum seeder is presented in Table 2.

Table 1: Test Conditions during the Field

Sr.No	Particulars	Situation/Operations
1	Farming situation	Rainfed
2	Location	IGKV Testing plot
3	Type of soil	Sandy loam
4	Area taken for study	(34×8, m^2) = 0.0272 ha
5	Field preparation	Ploughing, puddling and leveling

Table 2: Field Performance of Paddy Drum Seeder

Sr. No.	Parameters of Assessment	Findings
1	Depth of seeds and fertilizer placement (cm)	4.80 (Ranges from 3.55 to 5.80 cm)
2	Placement of seeds in rows (cm)	23.94 (1^{st} Furrow) 24.29 (2^{nd} Furrow) 23.51 (3^{rd} Furrow) 24.09 (4^{th} Furrow)
3	Placement of fertilizer in rows (cm)	23.40(1^{st} Furrow) 24.29 (2^{nd} Furrow) 23.62(3^{rd} Furrow) 23.97 (4^{th} Furrow)
4	Speed of operation (km/h)	2.26
5	Draft of a Machine (kgf)	35.97
6	Power requirement (kW)	0.23
7	No. of plants/m^2 per plot	19
8	EFC (ha/h)	0.138
9	Field efficiency (%)	61.57
10	Seed rate (kg/ha)	10.59
11	Fertilizer rate (kg/ha)	12.40

Whereas, the paddy drum seeder dropping seeds at 25 cm row to row spacing and about 25 cm plant to plant spacing required only 10.59 kg/ha seeds and 12.40 kg/ha fertilizer. Thus it could save the cost of cultivation of paddy crop by saving the seed and at the same it also saved the cost of fertilizer application by saving the fertilizer and labour. From the study, it can be concluded that the four row paddy drum seeder with fertilizer applicator could be used successfully reducing the drudgery of labours. Direct sowing reduced the cost of cultivation and increased the net profit per ha by avoiding nursery raising and also due to reduction in cost of transplanting. Maintaining row to row and plant distance facilitated to efficient take up of fertilizer by the plants and ease in carrying out plant protection and weed control operations. The duration of crop was reduced by 8 – 10 days and higher field capacity of the machine resulted in higher area coverage per unit of time as compared to the other practices. Seed rate was reduced to 10.59 kg/ha in drum seeder as against 62.5-75.0 kg/ha in nursery cum transplanting method.

Figure 3

CONCLUSIONS

It can be concluded that direct sowing with drum seeder with fertilizer attachment can help when there is a shortage of labour for transplanting and while applicating fertilizers, it increases the yield, reduces the crop duration, drudgery and cost of cultivation.

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